

The Applicants have carefully studied the outstanding Office Action. The present amendment is intended to be fully responsive to all points of rejection raised by the Examiner, and is believed to place the application in condition for allowance. Favorable reconsideration and allowance of the application are respectfully requested.

The applicants have filed new dependent claim 44, dependent on claim 1, and new claims 45-46 dependent on claim 40, which recite further patentable subject matter distinguishing the presently claimed invention from the prior art. Claims 44 and 45 recite the subject matter of the last element of previously filed claim 1, this subject matter being deleted from the presently amended claim 1. New claim 46 recites that the phase changing element is a liquid crystal element, having the equivalent dependency on claim 40 as claim 3 has on claim 1.

Claims 1-5, 8,14,26,27-31,35 and 36 are rejected under 35 U.S.C. 102(b) as being anticipated by Betts et al (U.S. Patent 5,930,441). The Examiner states that: “Regarding claims 1, 3,4,8, 14, 26, 27, 30, 35, and 36, Betts et al disclose a variable optical filter comprising an input fiber (3), an output fiber (6), a phase changing element (1, liquid crystal, electro-optic element [column 3 lines 22-23]) placed between the input and output fibers, a drive source operative to change the phase of light (see column 2 lines 38-40, column 3 lines 13-14,36-38) by rotation of an optical axis of the phase changing element (see column3 lines 33-36). Betts et al disclose that the phase changing element can be used as an optical attenuator or a mode-convert (see column 4 lines 17-22, 57-64).

Regarding claims 2, 28 and 29, Betts et al disclose the claimed limitations (see claim 18 of Betts et al).

Regarding claims 5 and 31 Betts et al disclose two liquid crystal films orthogonally aligned (see column 3, lines 26-27, 31-33)."

The applicant respectfully submits that the invention described in Betts et al. is different from that described and claimed presently. The Betts et al. device includes a phase changing element placed between the input and output fibers, but both the structure and the location of the Betts et al. phase changing element are different from that in the presently claimed invention. The Betts et al. phase changing element, its location and function within the device are described in col. 1, lines 46-50 as "a flat plate of glass(1) with one edge (2) carefully polished perpendicular to the plane surface (and) this edge splits the beam of a fibre beam expander. Light passing through the plate will experience a wavelength dependent phase shift compared with the light that does not pass through the plate." Such a phase changing element having "one edge carefully polished perpendicular to the plane surface" is not a simple component to manufacture, and if not accurately aligned, the polished edge will introduce unnecessary insertion losses. Furthermore, in the Betts et al. device, the phase shift imparted to part of the beam is adjusted either by mechanically adjusting the position of the element within the beam (including inserting more or less, or rotating, or tilting), or by keeping the element in a fixed position and adjusting the phase shift imparted to the whole element by means of an electrically adjustable electro-optical element or by means of liquid crystal layers applied to the whole of the element, as described in col. 3, lines 16-25 of Betts et al.

In contrast to what is described in Betts et al., amended claim 1 of the present application recites:

"A variable optical attenuator comprising:

- an input fiber for receiving an input optical signal to be attenuated;
- an output fiber for outputting said attenuated optical signal;
- an optical path disposed between said input fiber and said output fiber;
- at least one pixelated phase changing element, disposed in said optical

path such that part of said optical signal passes through at least one pixel of said at least one pixelated element; and

a drive source applied to said at least one pixel, operative to change the phase of that part of said optical signal passing through said at least one pixel.”

The applicant respectfully submits that nowhere is there mentioned or suggested in Betts et al., “a **pixelated** phase changing element, disposed in said optical path such that **part of** said optical signal passes through **at least one pixel** of said at least one pixelated element,” nor “a drive source applied to **at least one pixel of said at least one pixelated element, operative to change the phase of that part of said optical signal passing through said at least one pixel**” as recited in amended claim 1 of the present application (Emphases added).

The applicant respectfully submits that the use of such a pixelated phase changing element with the whole of the optical signal passing therethrough, simplifies the construction and operation of the presently claimed device, in comparison with that of Betts et al. Furthermore, since pixelation of such electrically adjustable phase changing elements had been known for at least two decades prior to the date of the Betts et al invention, the applicants submit that such use of a pixelated phase changing element cannot be considered as obvious in the light of Betts et al., since if this were so, it is not clear why Betts et al did not show or suggest use of such an element. Such use would have greatly simplified the construction and greatly increased the versatility of his invention.

The applicant therefore respectfully submits, in view of the above arguments, that amended independent claim 1 is not anticipated by Betts et al., and is thus free of those grounds of rejection under 35 U.S.C. 102(b), and respectfully request withdrawal of such rejection. The applicant further respectfully submits that similar arguments apply to counter the examiner’s rejection under 35 U.S.C. 102(b) of independent claim 26, which has been amended in a manner similar to the amendments made to claim 1.

Claims 1, 3, 9-11, 13, 15-17, 27, 30, 34 and 40-43 are rejected under 35 U.S.C.102(b) as being anticipated by Dupont et al (U.S. Patent 5,907,645). The Examiner states that:

“Regarding claims 1, 3, 27, 30, 40, 42 and 43, Dupont et al disclose input optical fibers and output fibers (A2, B2, A3, 83), a phase changing element (1, liquid crystal), a drive source (see column 5, line 41) controlling the phase changing element by rotation of the optical axis (see column 1 lines 42-48).

Regarding claims 15 and 16, Dupont et al disclose a reflecting surface (25) that is formed on the rear side of the phase changing element (see Fig. 9).

Regarding claims 9-11, 13, 17, 34, and 41, Dupont et al disclose the phase changing element that has two separate electrodes (4,5) which is separately controllable (see Fig. 4). Dupont et al also teach striped electrodes (see Fig. 8). Thus, Dupont et al inherently teach the claimed limitations.”

The applicant respectfully submits that those parts of the invention of Dupont et al., as described above by the Examiner, are different from the presently claimed invention. The Dupont et al. device includes, *inter alia*, two pairs of input and output fibers, having a phase changing element placed between the pairs, but the structure and operation of this phase changing element is different from that in the presently claimed invention. The Dupont et al. phase changing element has two pixels, but each pixel is disposed across **the entire cross section** of the optical path between one pair of input and output fiber, such that each pixel is associated exclusively with one optical path, and the phase of **the whole of the light** passing from one input fiber to its associated output fiber is varied by means of that pixel. The phase changing element in the invention of Dupont et al has no effect whatsoever on the mode structure of the light passing from an input fiber to an output fiber, such mode structure being completely unchanged.

In contrast to what is described in Dupont et al., amended claim 1 of the present application recites:

“A variable optical attenuator comprising:

an input fiber for receiving an input optical signal to be attenuated;

an output fiber for outputting said attenuated optical signal;

an optical path disposed between said input fiber and said output fiber;

at least one pixelated phase changing element, disposed in said optical

path such that part of said optical signal passes through at least one pixel of said at least one pixelated element; and

a drive source applied to said at least one pixel, operative to change the phase of light passing through said at least one pixel.”

The applicant respectfully submits that nowhere is there disclosed or suggested in Dupont et al., “at least one pixelated phase changing element, disposed in said optical path such that **part of said optical signal** passes through at least one pixel of said at least one pixelated element,” nor is there mentioned or suggested in Dupont et al., “a drive source applied to said at least one pixel, operative to change the phase of **that part of said optical signal** passing through said at least one pixel” as recited in amended claim 1 of the present application (Emphases added).

The applicant therefore respectfully submits that, in view of the above arguments, amended independent claim 1 is not anticipated by Dupont et al., and is thus free of those grounds of rejection under 35 U.S.C. 102(b), and respectfully requests withdrawal of such rejection. The applicant further respectfully submits that similar arguments apply to counter the examiner’s rejection under 35 U.S.C. 102(b) of independent claim 40, which has been amended in a manner similar to the amendments made to claim 1.

Claims 3-8, 11-25 are all dependent on claim 1, and recite additional patentable subject matter. Since claim 1 is deemed allowable, claims 3-8 and 11-25 are also thus deemed allowable.

New claims 44-45 are dependent on claim 40, and recite additional patentable material, and new claim 46 is dependent on claim 1, and recites additional patentable material. Since claims 1 and 40 are deemed patentable, claims 44-46 are also deemed patentable.

### **Claim rejections - 35 USC § 103**

Claims 6 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Betts et al (U.S. Patent 5,930,441) as applied to claims 1, 3, 27, and 30 and further in

view of Liu et al (U.S. Patent 6,141,076).

Claims 7, 12, 18 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dupont et al.

Claims 19-25, 37 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dupont et al and further in view of Wang et al (U.S. Patent 6,175,667 B1).

Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Betts et al. The Examiner has stated that:

“As described above, Betts et al disclose the claimed invention except a detector element and a drive circuitry for controlling the phase change. Betts et al teach the phase changing element is electrically tunable (see column 3 lines 12-13). Thus, one with ordinary skill in the art would have recognized a detector and a drive circuitry in Betts et al to effectively and precisely tune the phase changing element.”

Claims 27-38 have been cancelled without prejudice, such that the Examiner's rejection of claims 33, 37 and 38 under 35 U.S.C. 103(a) is deemed moot.

Furthermore, claims 6, 7, 12 and 18-25 are all dependent on claim 1, and recite further patentable matter. Lui adds nothing that would affect the allowability of claim 1, which is therefore allowable over both references or their combination. The applicant respectfully submits that since claim 1 is deemed allowable, claims 6, 7, 12 and 18-25 are also deemed allowable.

With regard to claim 39, the applicant respectfully submits that Betts et al does not disclose the invention as now claimed in amended claim 39, except for a detector element and drive circuitry for controlling the phase change. Claim 39 has been amended, in a similar manner to the amendments made to claim 1, to recite:

“An integrated variable optical attenuator, comprising:

an optical fiber for inputting and outputting an optical signal;

a pixelated phase changing element, disposed at an end of said fiber, such that part of said input optical signal passes through at least one pixel of said pixelated element;

a substrate reflecting light transmitted through said pixelated phase

at least one detector element, disposed such that it detects said reflected light not propagated back down said fiber; and

drive circuitry for controlling the phase change introduced in the passage of said part of said input optical signal through said at least one pixel of said pixelated phase changing element.”

The applicant respectfully submits that nowhere is there disclosed or suggested in Betts et al. or Lui et al., “a **pixelated** phase changing element, disposed at an end of said fiber, such that **part of said input optical signal** passes through at least **one pixel** of said pixelated element”, nor “drive circuitry for controlling the phase change introduced in the passage of said **part of said input optical signal** through said at least **one pixel** of said pixelated phase changing element” as recited in amended claim 39 of the present application (Emphases added).

The applicant therefore respectfully submits that amended claim 39 is not rendered obvious in the light of Betts et al. or Lui et al., and is allowable.

### Prior art made of record

The Examiner has made of record prior art which is not relied upon, but which is considered pertinent to applicant's disclosure, namely U.S. Patent Nos. 6,141,069 to Sharp et al., and 6,130,731 to Anderson et al which teach liquid crystal modulators, and U.S. Patent No. 6,560,396 to Yan et al., which teaches a variable optical attenuator having two segmented phase shifting means.

The applicant has carefully studied the above mentioned patents, and to the best of his understanding thereof, none of them affect the patentability of any of the applicant's claims, either alone or in combination with any other prior art.

## Conclusion

Applicant's attorney has made every effort to place this patent application in condition for allowance. It is therefore earnestly requested that the application, as a

Respectfully submitted,

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